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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

EEL2046 – ENERGY CONVERSION II (LE)

13 MARCH 2019
9:00 a.m. – 11:00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question Paper consists of 4 pages including the cover page with 4 Questions only.
2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print your answers in the Answer Booklet provided.

Question 1

(a) Figure 1 shows a round rotor DC Generator cross section diagram. Stator poles and rotor conductor current direction are shown in the diagram. You are required to re-draw the diagram in the answer booklet and find the following:

- Draw or state the direction of the generator rotor needed to be turn to have induced voltage at the brushes. [3 Marks]
- Name the four winding used in the Figure 1 diagram. [2 Marks]
- Indicate the conductor directions for all the conductors and poles for a successful DC Generator. (Note: conductor state into the page or out of the page and poles with N or S on the diagram in answer booklet) [4 Marks]
- Draw the GNA and MNA axis for Figure 1 diagram. [3 Marks]
- State what causes the shift of rotor to MNA and how it is corrected? [3 Marks]

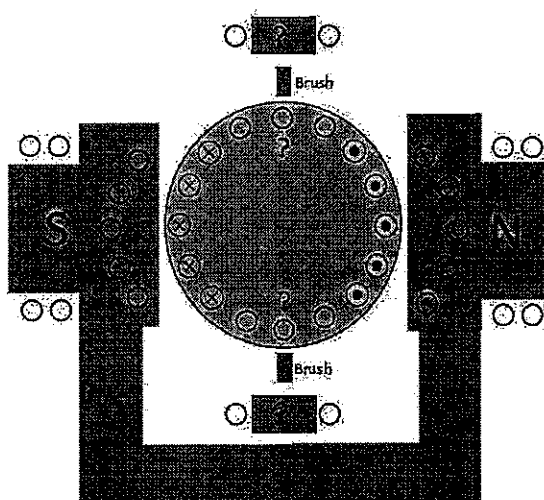


Figure 1

(b) A 12kW, 100V, 1000rpm, DC Separated Excited Generator has armature resistance of 0.05Ω , shunt field winding resistance of 80Ω and field turns of 1200 turns per pole. Shunt voltage of 100V given the generator. The magnetization characteristic at 1000rpm is as follows:

If	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6
Ea	8	30	59	76	87	95	101	105	107

- Find the critical field resistance at 1000rpm. [2 Marks]
- An adjustable resistance $R_{adj} = 0$ to 45Ω is connected in the field circuit. At no load what is the range of voltage adjustment that can be achieved by changing R_{adj} . [3 Marks]

Continued...

- iii) If the field resistance is allowed to vary from 0 to $45\ \Omega$ and the generator's speed is allowed to vary from 800 to 1000 rpm what are the maximum and minimum no-load voltages in the generator. [5 Marks]

Question 2

- (a) State and explain any two electrical braking methods applicable to dc shunt motors. Also draw the circuit diagram for both methods. [8 Marks]
- (b) A short-shunt cumulative compound DC motor of 6000W, 250V, 1800rpm has an armature circuit resistance of $0.3\ \Omega$, the series field resistance is $0.2\ \Omega$ and the shunt field resistance is $120\ \Omega$. If the rotation loss is 300W. Determine the followings:
- i. Draw the equivalent circuit and label them. [3 Marks]
 - ii. Copper losses of (P_{cs}) and (P_{cr}) [4 Marks]
 - iii. The developed torque (τ_d) [3 Marks]
 - iv. The shaft torque (τ_{out}) [3 Marks]
 - v. The efficiency (η) [1 Mark]
 - vi. Draw the power flow diagram and label them with calculated values. [3 Marks]

Question 3

- (a) Compare the constructional details and working principles of a dc series motor with a universal motor with the aid of diagram. Draw the torque-speed characteristics of a universal motor and explain why the characteristic of a universal motor on an ac source is different from the characteristic of the same motor on a dc source? [11 marks]

- (b) A single-phase split-phase motor of 120V, 50Hz, $\frac{1}{2}$ hp, 1750 rpm gave the following test results:

Blocked-rotor test (with auxiliary winding open): $V = 40\text{ V}$, $I = 5.6\text{ A}$, $P = 115\text{ W}$

No-load test (with auxiliary winding open): $V = 120\text{ V}$, $I = 4\text{ A}$, $P = 110\text{ W}$

Stator main winding resistance = $1.80\ \Omega$

- i) Draw the equivalent circuit of the motor with the auxiliary winding open. [4 Marks]
- ii) Calculate and mark the values R_1 , R_2 , X_1 , X_2 and X_m of the parameters in the circuit (i). [8 Marks]
- iii) Also find the No-load rotation loss. [2 Marks]

Continued...

Question 4

(a) Name the application of the below types of special machines. It could be an appliance used in home or industry.

- i. Squirrel Cage Induction Motor [2 Marks]
- ii. Universal Motor [2 Marks]
- iii. Induction Motor [2 Marks]
- iv. Servo Motor [2 Marks]
- v. PMSM Permanent Magnet Synchronous motor [2 Marks]

(b) A six step brushless DC motor (BLDC) has 2 pole rotor and 3 pole stator with sequence of RGB. There is three hall effect connected. The rotor turns clockwise.

- i) Draw the cross section of the BLDC motor and label them. [4 marks]
- ii) Draw the circuit connection between the BLDC in section (i) to its PLC control circuit and label them. [4 marks]
- iii) Plot the timing diagram for one mechanical rotation of the BLDC. You are required to draw three hall effect input and three semiconductor switching output diagram all in one plot. [7 marks]

End of Paper

